(12) UK Patent Application (19) GB (11) 2 368 759 (13) A

(43) Date of A Publication 08.05.2002

(21) Application No 0202514.6

(22) Date of Filing 12.01.1998

Date Lodged 04.02.2002

(30) Priority Data
(31) 8782174 (32) 14.01.1997 (33) GB

(62) Divided from Application No 9916132.5 under Section 15(4) of the Patents Act 1977

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(51) INT CL^7
H03M 13/23 , H04L 1/18

(52) UK CL (Edition T)
H4P PENL PEP

(56) Documents Cited
US 5487068 A

(58) Field of Search
UK CL (Edition T) H4P PENL PEP
INT CL^7 H03M 13/00 13/23 13/27 13/51 , H04L 1/00 1/16 1/18
Online: WPI, EPODOC, JAPIO

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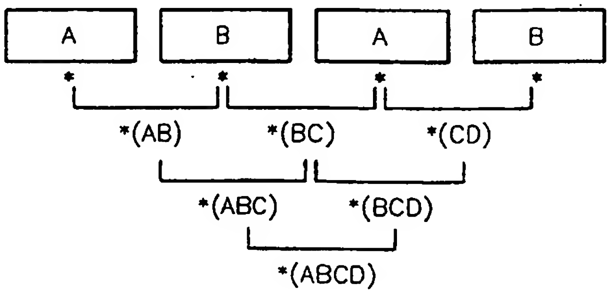
(54) Abstract Title
Error prevention method for multimedia data packets

(57) An error prevention method for multimedia improves data recovery and channel throughput in channels which cause a random error and a burst error by using a rate compatible punctured convolutional code (RCPC) and an automatic retransmission on request (ARQ). In a process of decoding a plurality of packets of given information, the error prevention method includes the steps of a) decoding one of the plurality of packets, b) decoding another packet when an error occurs during the decoding in step a), c) decoding a combination of the packets from steps a) and b) when an error occurs in step b), d) receiving and decoding a further packet when an error occurs in step c), e) decoding combinations of received packets when an error occurs in step d), and repeating steps d) and e) until the decoding error no longer occurs. The error prevention method has the characteristics of both Type-1 and Type-2 ARQ methods. Therefore, one can obtain constant channel throughput in the burst error containing channel, the random error containing channel, and a channel wherein the two error patterns coexist simultaneously.

FIG. 5



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

FIG. 1 (PRIOR ART)

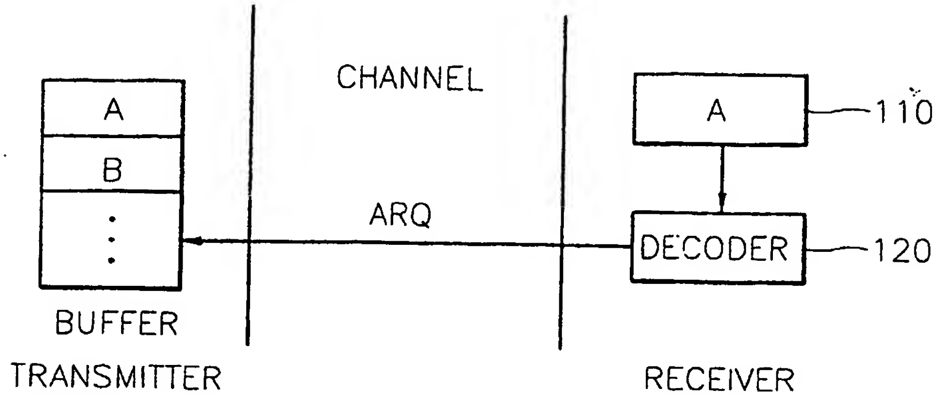


FIG. 2 (PRIOR ART)

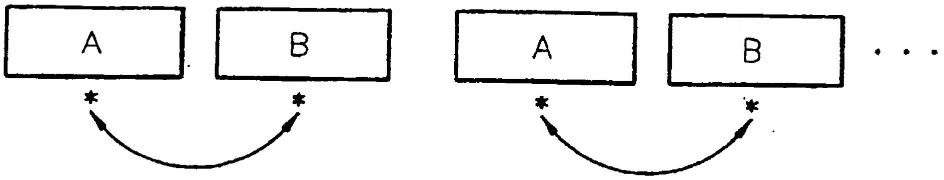


FIG. 3 (PRIOR ART)

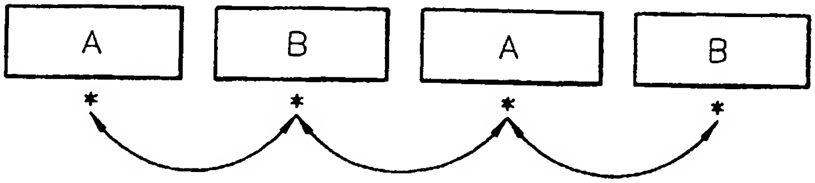


FIG. 4

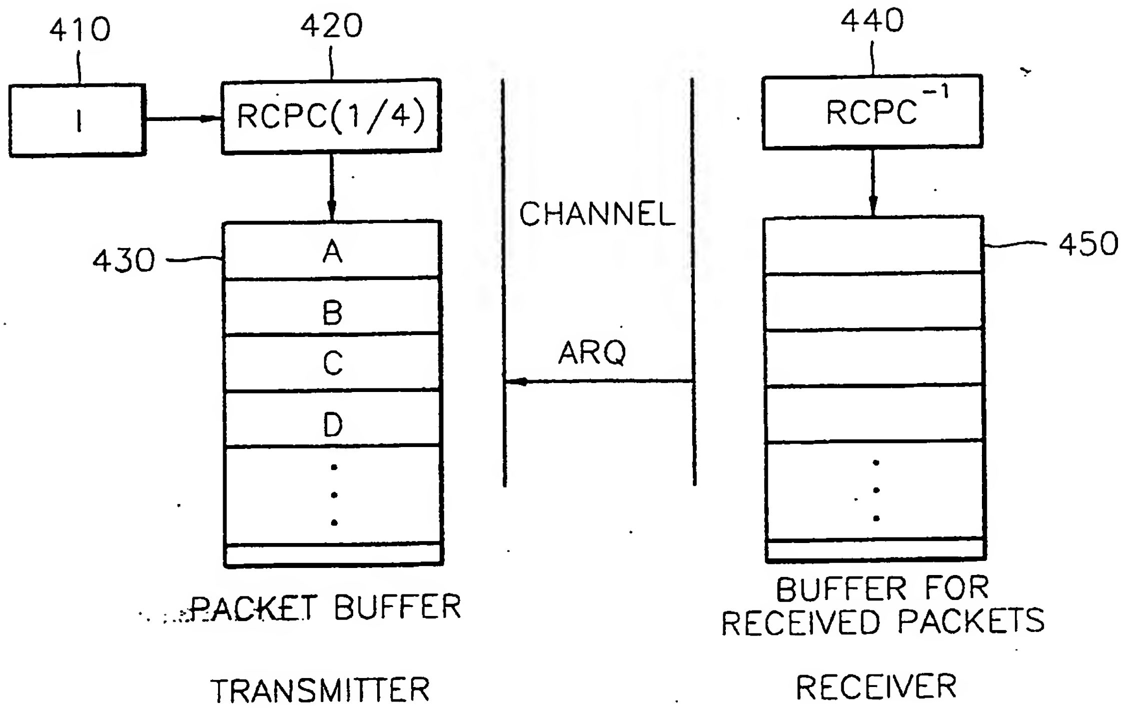

410
420
440
I
RCPC(1/4)
RCPC^{-1}
CHANNEL
430
A
B
C
D
450
ARQ
PACKET BUFFER
BUFFER FOR RECEIVED PACKETS
TRANSMITTER
RECEIVER

FIG. 5

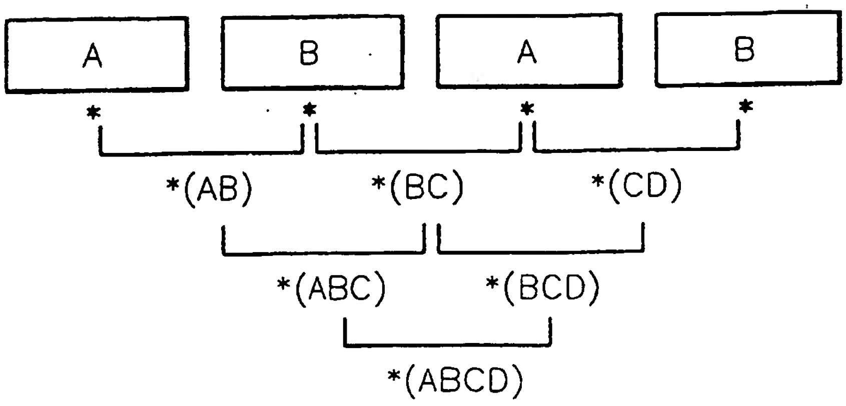
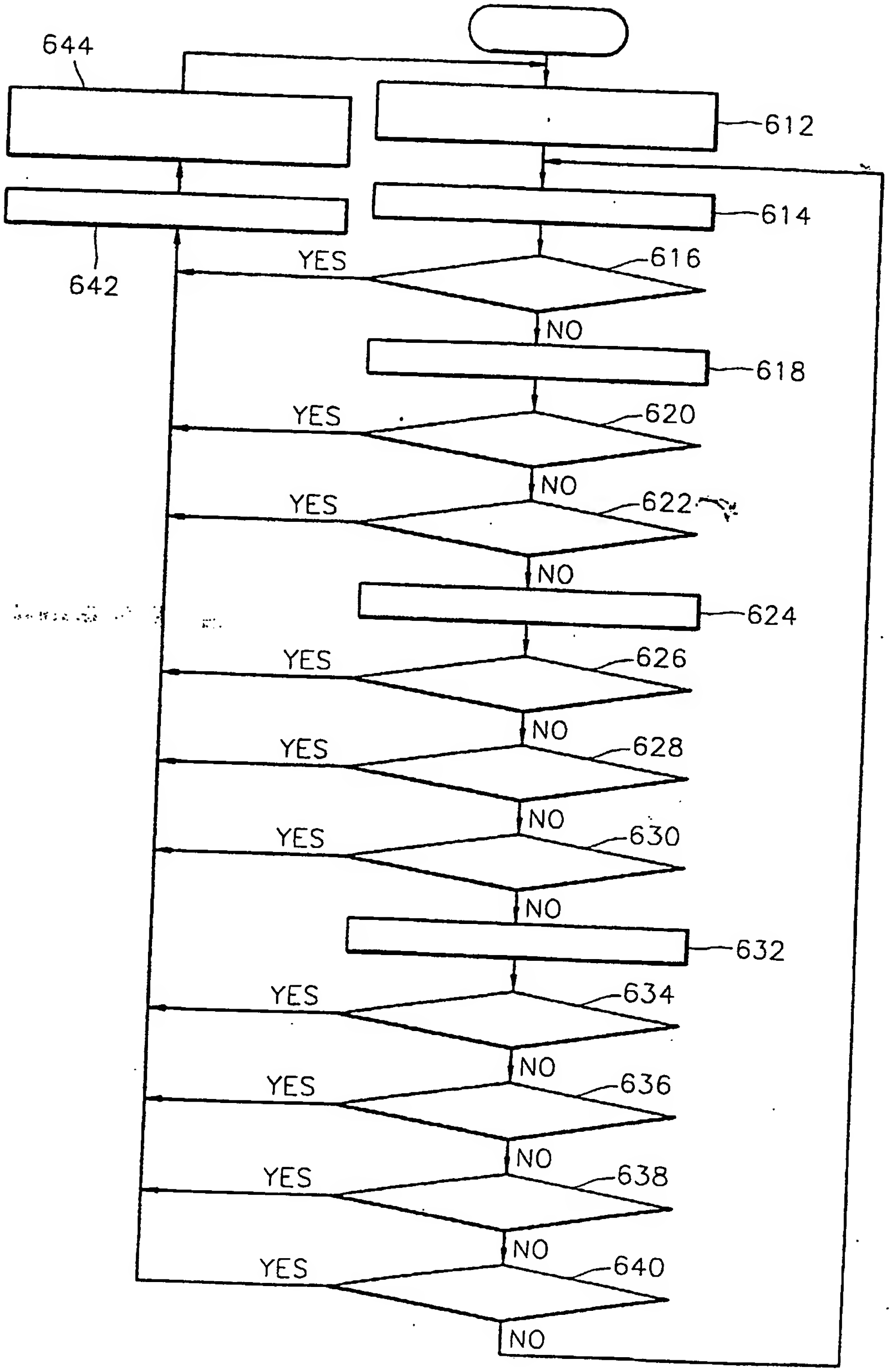

A
B
A
B
*
*
*
*
*(AB)
*(BC)
*(CD)
*(ABC)
*(BCD)
*(ABCD)

FIG. 6


644
612
614
642
616
YES
NO
618
620
YES
NO
622
YES
NO
624
626
YES
NO
628
YES
NO
630
YES
NO
632
634
YES
NO
636
YES
NO
638
YES
NO
640
YES
NO

ERROR PREVENTION METHOD FOR MULTIMEDIA

Technical Field

The present invention relates to an error prevention method for multimedia, and more particularly, to a method for improving data recovery and channel throughput in channels wherein a random error and a burst error occur by using a rate compatible punctured convolutional code (RCPC) and an automatic retransmission on request (ARQ).

Background Art

Let us consider multimedia terminals which transmit and receive arbitrary packets of data (video, audio, data, or a mixed form of any of those three). The transmitter transmits information packets, for example, I, J, and other packets. For each information packet, the transmitter forms N-sized bit-streams which are different representations of given information packets. For example, the transmitter can generate a packet A (B, C, or D) for given information packet I. Type-1 and Type-2 are different in that they use different retransmission methods. The packets to be transmitted are formed using either convolutional code or RCPC.

FIG. 1 is a block diagram showing a general situation of data transmitted and received using ARQ. The basic concept of Type-1 ARQ will be described as follows with reference to FIG. 1. When a transmitter transmits a packet A having a length of N, a packet decoder 120 in a receiver starts decoding the received packet A 110. At this time, if errors occur in the packet A and no further decoding is possible, for example, channel coding is not employed, channel coding having a 1-bit error or more is employed or, more errors than a channel coder can detect and correct occur, the receiver asks the transmitter to send the same packet A again. Here, retransmission would be repeated either until the decoder 120 receives an error-free packet A, or for some specific number of iterations to perform transmission and receiving with respect to the next packet. Type-1 ARQ is very effective in burst-error containing channel. Next, Type-2 ARQ will be described. Up to now, there are three types of Type-2 ARQ, i.e., a basic type, a Class A and a Class B, each of which uses RCPC given information I (J,K....).

FIG. 2 is a conceptual diagram showing the operation of the basic type, wherein arrows represent combination. Here, given information I, the transmitter generates packets A and B using RCPC at a rate of ½ and transmits only the packet A. The decoder in the receiver attempts to decode the packet A. If successful, the decoder then attempts to decode the first packet of two for the next information J. Otherwise, the receiver asks the transmitter to send the packet B. Also, the decoder attempts decoding a combination of packets A and B. If successful, the decoder then attempts to decode the first packet of two for the next information J. Otherwise, the receiver asks the transmitter to send the packet A again and all of these procedures are repeated. The basic type has an advantage in that implementation is not so complicated.

FIG. 3 is a conceptual diagram showing the operation of the Class A packet (Lin-Yu), wherein * denotes self-decoding and arrows represent combination. The operational principle thereof is similar to the basic type except how to combine packets A and B when both packets fail to be decoded. That is, the decoder attempts decoding the combination of packets A and B, and if it fails, the receiver asks the transmitter to send the packet A again. Next, if the decoder succeeds decoding only the packet A, the next information J is processed, and if the decoder fails, the receiver combines the previously stored packet B and currently received packet A (i.e., in general, interleaves the two) to attempt decoding. This method is more effective in a random error containing channel rather than in a burst error containing channel.

Next, Class B is significantly more complicated than the basic type and the Class A. The basic concept thereof is based on the Class A. First, the Class A (Lin-Yu) is performed by generating the packets A and B given the information I using RCPC at a rate of ½. As described above, the Type-1 ARQ is greatly effective in the burst error containing channel. However, with Type-1 ARQ, retransmission would be more frequent in the random error containing channel, which causes drastically lower channel throughput. Even though Type-2 ARQ allows good performance in the random error containing channel, retransmission would be more frequent in the burst error containing channel: therefore, channel throughput can be lowered.

Disclosure of Invention

It is an object of the present invention to provide a method for maintaining channel throughput at a certain level in a random error containing channel and a burst error containing channel by operating like Type-1 in the burst error containing channel, while operating similarly to a basic type or a Class A of Type-2 in the random error containing channel.

To accomplish the above object, there is provided an error prevention method in a method for decoding a plurality of packets of given information, comprising the steps of a) decoding one of the plurality of packets, b) decoding another packet when an error occurs in the decoding in step a), c) decoding a combination of the decoding error packets when an error occurs in step b) or the third packet, and d) repeating step c) until the decoding error no longer occurs.

Brief Description of the Drawings

The above object and advantage of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the attached drawings in which:

FIG. 1 is a block diagram showing the general situation of data transmission and reception using an ARQ method;

FIG. 2 is a conceptual diagram showing the operation of a basic type;

FIG. 3 is a conceptual diagram showing the operation of a Class A;

FIG. 4 is a block diagram showing the structure of an apparatus for realizing error prevention according to the present invention;

FIG. 5 is a conceptual diagram showing a procedure for processing of received packets A, B, C and D in a decoder of a receiver shown in FIG. 4; and

FIG. 6 is a flow chart showing a procedure for processing received packets in a decoder according to the present invention.

Best Mode For Carrying out the Invention

The present invention is a method for performing a hybrid-type ARQ which mixes Type-1 and Type-2 methods.

Referring to FIG. 4, an error prevention apparatus includes: a transmitter provided with a packet buffer 430 for producing packets A, B, C and D using an

RCPC 420 having a rate of 1/4 for given information packet I 410; an inverse RCPC 440; and a receiver provided with a buffer 450 for storing the received packet, for sending an ARQ and a packet number to the transmitter via a channel. In FIG. 4, an RCPC logic is fixed at a rate of 1/4. A portion comprised of four arbitrary polynomials which satisfies a locally invertible characteristic simultaneously produces RCPC-processed packets A, B, C and D. Also, the transmitter has a maximum of four retransmissions. Here, the local inversion in the RCPC denotes that original information I can be obtained with any one of the packets A and B and with a combination of the packets A and B.

FIG. 5 is a conceptual view showing a procedure for processing the received packets A, B, C and D in the decoder of the receiver shown in FIG. 4, wherein * indicates self-decoding and a bracket indicates a combination of packets (generally, an interleaving operation).

FIG. 6 is a flow chart outlining a procedure for processing the received packets in a decoder according to the present invention.

As shown in FIG. 6, the transmitter produces packets A, B, C and D using the RCPC 420 in step 612. The first packet A is transmitted to the receiver in step 614. The decoder attempts decoding the packet A in step 616. In step 616, if the packet A is decoded, the decoded results are stored in the buffer 450 (step 642) and the job for other information (e.g., information J) proceeds (step 644); otherwise, an ARQ signal is sent to the transmitter to request transmission of the packet B (step 618). The decoder attempts decoding only the packet B in step 620. If successful, the decoded results are stored in the buffer 450 in step 642 and the job for other information (e.g., information J) proceeds in step 644. If the decoder fails. it then attempts to decode the combination of the packets A and B in step 622, which is indicated by *AB in FIG. 5. At this time, if the combination of the packets A and B as shown in FIG. 5 are decoded, the decoded results are stored in the buffer 450 (step 642) and the job for other information (e.g.. information J) proceeds (step 644). If the combination of the packets A and B is not decoded. the transmitter is requested to transmit the packet C by sending the ARQ signal thereto in step 624. The decoder then attempts decoding only packet C in step 626. If successful. the decoded results are stored in the buffer 450 in step 642 and the job for other information (e.g.. information J) proceeds in step 644. Otherwise. the decoder attempts to decode the combination of the packets B and C in step 628, which is indicated by *BC in FIG. 5. If the combination of the packets B and C is successfully decoded, the decoded results are stored in the buffer 450 (step 642) and the job for other information (e.g., information J) proceeds (step 644). If the combination thereof is not decoded, the combination of packets B and C is combined with packet A as shown in FIG. 5 as *ABC and decoding is attempted in step 630. Here, if the combination of packets A, B and C is decoded, the decoded results are stored in the buffer 450 (step 642) and the job for other information (e.g., information J) proceeds (step 644). Otherwise, the transmitter is requested to transmit the packet D by sending the ARQ signal thereto in step 632. The decoder then attempts decoding only the packet D in step 634. If successful, the decoded results are stored in the buffer 450 in step 642 and the job for other information (e.g., information J) proceeds in step 644. Otherwise, the decoder attempts to decode the combination of packets C and D in step 636, which is indicated by *CD in FIG. 5. If the combination of packets C and D is decoded, the receiver stores the decoded results in the buffer 450 (step 642) and performs the job for other information (e.g., information J) (step 644). Otherwise, the receiver combines packets C and D with packet B as indicated by *BCD in FIG. 5 and attempts decoding the combination in step 638. Here, if the combination of packets B, C and D is decoded, the decoded results are stored in the buffer 450 (step 642) and the job for other information (e.g., information J) proceeds (step 644). Otherwise, the receiver combines packets B, C and D with packet A as indicated by *ABCD in FIG. 5 and attempts decoding combination in step 640. If the combination of packets A, B, C and D is decoded, the receiver stores the decoded results in the buffer 450 (step 642) and performs the job for other information (e.g., information J) (step 644). Otherwise, the process returns to step 614 to repeat all of these procedures until no errors occur. Meanwhile, the receiver stores the decoded results in the buffer 450 in step 642 and performs the job for the next information (e.g., information J, K....) in step 644.

Industrial Applicability

As described above, the present invention has the characteristics of both Type-1 and Type-2 ARQ methods, therefore, one can obtain constant channel throughput in the burst error containing channel, the random error containing channel, and a channel where the two error patterns coexist simultaneously. In the burst error containing channel, the method of the present invention is performed nearly the same as or better than the Type-1 method and much better than the Type-2 method. As for the random error containing channel, since the method of the present invention is performed similar to the Type-2 method, it also performs almost the same as the Type-2 method, but much better than the Type-1 method.

What is claimed is:

1. A method of protecting against errors during the decoding of a plurality of packets of given information, comprising the steps of:

a) decoding one of said plurality of packets;

b) decoding another packet when an error occurs during said decoding in said step a);

c) decoding a further packet when an error occurs during said decoding in step b); and

d) repeating said step c) until no decoding error occurs.

2. A method for protecting against errors during the decoding of a plurality of packets of given information, comprising the steps of:

a) receiving and decoding one of said plurality of packets;

b) receiving and decoding another packet when an error occurs during said decoding in said step a);

c) decoding a combination of any received packets when an error occurs during said decoding in said step b); and

d) receiving a further one of said plurality of packets when an error occurs during said decoding in said step c), and decoding a combination of said further packet and at least one of the other received packets.

3. A method for preventing errors during the decoding a plurality of packets of given information, comprising the steps of:

a) decoding one of said plurality of packets;

b) decoding another packet when an error occurs during said decoding in said step a);

c) decoding a combination of said packets of said steps a) and b) or a third packet when an error occurs during said decoding in said step b); and

d) repeating said step c) until said decoding error no longer occurs.

4. An error prevention method as claimed in claim 3, further comprising the step of, storing said decoded results and standing by decoding of a plurality of packets of the next information when said decoding error no longer occurs during said steps a) to d).

5. An error protecting method as claimed in claim 3, wherein, at least two decoding error packets are combined and decoded when the number of said packets in said step c) is at least three.

6. An error prevention method as claimed in claim 5, wherein decoding is sequentially performed starting from when the number of combined packets is two and including a latest packet determined to be a decoding error packet.

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INVESTOR IN PEOPLE

Application No:	GB 0202514.6	**Examiner:**	Steven Davies
Claims searched:	1,3-6	**Date of search:**	26 February 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): H4P-PENL, PEP

Int Cl (Ed.7): H03M-13/00, 13/23, 13/27, 13/51 ; H04L-1/00, 1/16, 1/18

Other: Online databases: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	US5487068 (SMOLINSKA et al)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.